AN Introduction to THE.



UNIVAC* File-Computer System

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General Outline of Component Units

The Univac File-Computer System is an electronic computer system which provides for magnetic filing combined with electronic computing for random access processing of unsorted data. It has common language versatility and many types of input-output may be used simultaneously. Input-Output units, and storage units can be put together as buildingblock units to produce a system satisfying individual requirements. Such a system is expandable at any time.

The five components of any computer system are input, storage, arithmetic, control and output. The Univac File-Computer System has these components but the type number and capacity of some of these units in any grouping of equipment is determined by the individual application requirements. The following is a general outline of the building blocks in these components:

Input

Actually, the File-Computer System is universal insofar as input is concerned. Up to 24 units of input, input-output, output could be put in a system and these units could be working simultaneously. Such devices include:

Card Sensing and Punching Unit - Input/Output 10 Key Keyboard with Input Printers 10 Key Inquiry Keyboard with Input-Output Printer Key Actuated Tabulating Card Punch Input-Output Electric Typewriter Input-Output Perforated Paper Tape Input-Output (5, 6, or 7 Channel Tape) Magnetic Tape Input-Output

Storage

The File-Computer System has several different types of internal storage:

Input-Output Intermediate Storage Section High Speed General Storage Unit Large-Capacity General Storage Unit

Input-Output Storage

The purpose of this unit is to accept data from and deliver data to the input-output device or devices, to store the input data until it is called into the system, to store output data until it is accepted by the related output devices.

Intermediate Storage

The Intermediate Storage unit provides a method of storing either constant information or developed information. Intermediate Storage has a capacity of 20, 11 digit data fields plus signs.



High-Speed General Storage Unit

A High-Speed General Storage unit of the random access type may be included as a building block in a system. Such a storage may be used either for stored instructions directing the program, for regular data storage, or a combination of both. High-Speed General Storage Units can be either one of two capacities: 190, 11-character fields; 990, 11-character fields. In each field there is an additional character for sign value.

Large Capacity General Storage Unit

A Large Capacity General Storage Unit of the random access type can be included in any system. This storage can be increased by adding from 1 to 9 Large-Capacity General Storage Expansion Units as required. Each storage unit has a capacity of 180,000 alphanumeric characters for a possible total Large-Capacity storage of 1,800,000. According to the individual applicational requirements, these characters can be grouped in units within certain limitations. These groupings are called Unit Record Areas and such a grouping is analogous to a punched card as a unit record. These established Unit Record Areas can be divided into fields at the will of the programmer similar to the division of a punched card into fields.

Arithmetic Unit

In the File-Computer System, this unit handles all data entering or leaving the system or going from one unit to another. It performs the process of addition, subtraction, multiplication and division. In performing this process it takes two values, V_1 and V_2 , together with their signs and arrives at a result, R, with its sign. The necessary decimal alignment is made for each step in calculations. The arithmetic unit also is used in comparison of alphanumeric data, transferring data to different locations, and it provides a method for searching for data on the Large Capacity General Storage Unit.

Control Section

The purpose of the control section is to guide the Computer through the routine of steps necessary to arrive at the desired result. This direction on the Univac File-Computer is accomplished by two major means: connection panel wiring which is external programming; and stored instructions which is internal programming. The external or internal programming is developed to handle the individual requirements.

Because the File-Computer System can operate with many input/output units working simultaneously some method must be employed to avoid a traffic jam. This control is accomplished by the Multiplexing Unit.

Output

There are many types of output devices on the File-Computer System. Some of these output devices are in turn used as input devices. The



following output devices are used:

Card Sensing and Punching Unit - Input/Output 10 Key Inquiry Keyboard with Input-Output Printer Key Actuated Tabulating Card Punch Input-Output Electric Typewriter Input-Output Perforated Paper Tape Input-Output (5, 6, or 7 channel tape) Magnetic Tape Input-Output

Possible Ways of Operation

The Univac File-Computer System can be put together in various combinations of units to provide a system most suitable to individual requirements. And how each system actually operates will be determined by the problem to be solved; however, there are two main ways of operation: On-line and off-line.

On-Line

In an on-line operation an operator puts information into the system by direct key entry. As an example of an on-line operation, let us take an application involving Billing, Sales and Inventory. The Electric Typewriter can be an input-output device in the Computer System. Invoices can be typed on the Electric Typewriter, and automatically extensions of quantity times unit price can be made in the arithmetic unit of the Computer System. The extension as calculated can be output and automatically printed on the invoice. Invoice totals and discounts can be automatically calculated and printed. In addition the quantities and dollars could be stored in the Large-Capacity Random Access Drums as Sales and inventory information.

Off-Line

In, an off-line operation the operator transcribes the source data to another media, such as punched cards. Information is entered into the system from the transcribed media. An example of an off-line use would be extending a bill of material and testing inventory availability as a single operation. The inventory available balance by part number can be stored on the Large Capacity Drums. The quantity on order is multiplied by the parts usage. As each part is extended on the bill of materials, the total is deducted from the available balance. If a credit balance occurs, a parts shortage exists.

Cards could be punched to signal a shortage condition.

Advantages of the Univac File-Computer System

With some broad outline of the components of the system and the ways of operation in mind, we can be more specific about the purpose and advantages of the File-Computer. The primary reason for engineering the Univac File-Computer System is to enable one to keep a current balance for a large number of items with high volume activity. On either an on-line or off-line operation, entries affecting this balance could come from many types of input equipment and answers delivered through different types of output.

ON-LINE OPERATION

direct keyboard input of data to be processed



previous keyboard entry of data to be processed

OFF-LINE OPERATION

Previous systems of maintaining a balance, whether by completely manually posted records, bookkeeping machines, punched cards, or general purpose Electronic Data Processing equipment have certain disadvantages. In these systems where the reference file is large it is necessary to accumulate batches of items for processing before the information can be economically handled.

In maintaining a manually posted record it is often the practice to use sorting devices to group documents for sequential posting since random posting is slow and expensive. Sometimes, following sorting, groups are totaled on an adding machine and the group total posted. Often tabulating machines have been employed for sorting and adding information in preparation for sequential posting of records.

In maintaining a record on a bookkeeping machine where the ledger file is extensive and activity high it is common practice to prepare ledger sheets or offset them to make the posting process faster. Stuffing the ledger is an accepted practice for faster and more economical operation.

In a tabulating system although many operations are mechanized a series of steps - punching, sorting and tabulating - are necessary for balance forward applications. If one has an extensive file and relatively few entries it is hardly economical to punch, sort, collate, tabulate and summary punch new balance forward cards. If the entries are great in number and it becomes more economically feasible there still remains a time interval between getting original media and securing a balance. Most of the Electronic Computers presently available have the same problem as tabulating in securing balance figures.

In any of the above systems not only do we have an economic problem in getting a balance but we cannot get a true current balance because of the time lag in handling the necessary information. For example let us take inventory on punched cards. A cutoff time would have to be established, all the source media collected, punched, sorted, collated, tabulated and summary punched to arrive at a balance that was the current balance at the time of cutoff. The actual current balance may be quite a different figure than indicated in the tabulated report.

Besides the inability to keep a current balance on high volume activity for a number of items, present methods do not permit access to the record by more than one person simultaneously. This, of course, contributes to the fact that we cannot maintain a current balance but, in addition the facts of the record are not available to more than one person at a time.

Under previous methods it was difficult to handle late items and rush items. For example, let us take Inventory and Pre-Billing where orders are checked to inventory balances prior to invoicing. If we had been out of stock and merchandise came in a short time ago ordinarily there is a time lag before the merchandise can be recorded as inventory. If orders are passed over the inventory



FREE - RUNNING OPERATION

record and the new inventory has not been recorded then we have a short shipment with consequent loss of income. If we had rush orders, we would have problems of inventory checking as well as handling the invoicing individually.

The Univac File Computer System provides many advantages over previous methods:

- 1. Random access feature provides large file of information readily accessible to many types of input-output devices.
- 2. Eliminates necessity of batching items as in previous systems. Information can be fed into the system at any time with ready access to balances.
- Random access feature eliminates many interim steps associated with other methods such as sorting and collating. Postings can be made from source documents which are kept in their original sequence.
- 4. Same record filed magnetically is available to all input-output devices simultaneously. Then all operators can post to the same record even making entries to the same items at the same time.
- 5. Keyboard entries can be made directly into the system.
- 6. Eliminates searching for a record card.
- 7. Gives freedom in handling late items.
- 8. Gives freedom in handling rush items.
- 9. Cumulative total of all entries is constantly available.
- 10. Through on-line and off-line operation, the system, can handle several applications simultaneously and use common information according to different activities.



HIGH-CAPACITY GENERAL STORAGE

*There are 600 characters per channel, divided into standard areas of 12, 15, 20, 24, 30, 40, 50, 60, 75, or 100 characters each.



HIGH - SPEED GENERAL - PURPOSE STORAGE



ON-LINE BILLING WITH TYPEWRITER INPUT-OUTPUT

Combined billing, inventory control and sales analysis -- all in a single high-speed operation -- is a featured application of the new Univac File-Computer System.

Providing millisecond access to any desired information from a mass of data filed on high-capacity magnetic drums, the File-Computer eliminates most of the manual or machine steps usually required for matching up the customer order data with related master description, inventory balances, prices, sales-to-date totals, and other data required in the processing.

In practical terms, this means that customer orders can be processed immediately and completely -- in the order of their arrival -- and that up-to-the-minute figures on inventory and sales are available instantly just by pressing a key.

The unique Multiplexer unit of the File-Computer system permits the simultaneous operation of up to 24 different input-output units. In this way, up to 100,000 invoice line items or other input data may be processed in a six-hour day -- each handled according to its own program instructions. Input-output units may be any combination of 80 or 90 column punched card, paper or magnetic tape, typewriter or ten-key tape printing devices -- permitting great flexibility of procedure in alpha-numeric data processing.

The Univac File-Computer can also provide up-to-the-minute transaction and control data for payroll, general ledgers, cost accounting, production control and other needs. It may be used for either a single large application or for several smaller applications handled simultaneously.

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As with the other data-processing systems of the Univac series, the File-Computer's results are assured of accuracy by built-in selfchecking features. Programs do not have to be run twice to be proved.

Because of the high-speed random access, no sorting, merging, collating, reproducing, or pulling of cards from a tub file is required before the processing can begin. Nor is there any need to wait until an economic batch or data has been accumulated.

Master and control data is filed on magnetic drums in unit record areas of a standard size, determined in planning the application. If, for instance, the application requires 40 characters of filed data for each item, then a single magnetic drum would hold the data for 4500 item records. Up to ten drums may be used, for a maximum of 45,000 item records of this size.

For a billing application, the unit record area can be subdivided as needed for item number, item name, warehouse location, one or more unit prices, inventory balance, sales-to-date total, sales by customer type, unit cost-of-sale, etc.

From the above data, many computations can be made at millisecond speed for each line item. The inventory balance can be checked to determine backorders. The price can be selected according to customer type. Extensions can be made for partial or complete shipment. And the invoice total can be accumulated.

In the same operation, of course, a new inventory balance and one or more new sales-to-date totals can be computed and refiled on the magnetic drum.

One feature of this computer is that it permits true on-line operation. For instance, with typewriter input-output, as the operator makes the original entries from customer order, the data would be entered directly into the computer

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and the invoice figures would be automatically typed out on the same invoice line.

In such an on-line operation, the typist would enter the code for customer type only once on each invoice. Then, immediately after she had entered the item number and quantity ordered for each line item, the machine would automatically type out data such as the item description, the warehouse location, the quantity shipped and/or backordered, the selected unit price, and the line-item extension. At the end of the invoice, the machine would automatically type out data such as discounts and net total.

An off-line billing operation might be handled on the same computer. For instance, suppose that some customer orders are received from branches on perforated paper tape. Data from these tapes could be fed directly into the system and processed, with complete invoices written automatically on typewriters. This tape billing could be handled simultaneously with the on-line billing.

Another instance of the programming versatility of this system would be the use of tape input for continuous checking of inventory and sales performance simultaneously with billing. In this case, the tape would contain information on each item such as sales quota and re-order point. Automatic computations could be made to determine which items vary significantly from the sales quota and which items have reached the re-order point. Each such exception would be typed out, supplying condensed reports on items requiring executive attention.

In another case, magnetic tape might be used for input and output, providing for common-language communication between the File-Computer System and a large Univac System handling the central records of a large company.

Where punched cards are used for input and output, the File-Computer provides the fastest means of preparing the complete cards which can then be used over and over for producing various documents and reports.

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Similarly, one typewriter (or a ten-key tape printing device) might be used for making inquiries whenever information is needed on the inventory or sales status of a particular item, with the File-Computer supplying answers immediately. This inquiry unit might also be used to adjust inventory for shipments received and to compute new average prices.

As stated before, up to 100,000 items can be processed in a single day -- depending only on the number of computations required per item. Of course, the number and type of input-output units will determine whether the system is used to its full capacity. In many cases, it will be possible to add more applications, even including scientific and engineering mathematics, in order to get full return on the investment.

The unusual versatility of the File-Computer has been achieved through the broad combination of computer engineering skills and business recordkeeping experience embodied in the Remington Rand organization. The magnetic drum techniques, on which this system is based, were pioneered by Engineering Research Associates Division of Remington Rand Inc., which today is recognized as manufacturer of the most dependable magnetic drums for industry and government.

Operating at millisecond speeds, the Univac File-Computer System may be said to take the shortest route from the source figures to the transaction record and the management report. In addition to savings in operating costs, it will provide management with timely and significant figures which are the basis of making sound decisions. In both ways, the Univac File-Computer System will prove an effective means for many firms to gain that constant objective of management: a definite edge on competition.

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NEW APPROACHES TO PRODUCTION CONTROL

New random-entry procedures which eliminate long, costly work on production control are made possible by the Univac File-Computer, a versatile new type of alpha-numeric data processing system.

The File-Computer system features immediate access to large-scale magnetic files of machine loading and operation scheduling data. This new approach saves valuable hours or days in producing the figures required to eliminate machine bottlenecks before they occur, meet manpower requirements economically, and investigate immediately any variation from schedule at any stage of a job in the manufacturing process.

Many unusual features

All production data can be processed in its order of arrival to the tabulating room, eliminating the manual pulling of cards or elaborate sorting operations usually required in order to match new data with previous totals and master data. Up to 100,000 job cards and move tickets can be processed in a six-hour day. In a single pass of the cards, complete computations can be made for both machine loading and operation scheduling of new work.

The Multiplexer unit permits simultaneous operation of up to 24 inputoutput units, which can be any combination of card, keyboard printing, and magnetic or perforated tape units. Examples for production control would be the use of two high-speed card sensing-punching units to do the same work twice as fast, or to handle different tasks in the same program. . .the use of an electric 'typing or ten-key printing unit for inquiring at anytime about the current status of machine loads and operation schedules...and even the use of a magnetic tape unit for intercommunication with a large Univac System for company-wide

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coordination of production.

The File-Computer provides automatic verification of every arithmetic result -- a built-in feature which requires no programming steps. Similarly, automatic means are provided for electronic checking to insure correct transfer of each alpha-numeric character on every processing step.

Available in building-block units, each File Computer system can be designed to meet the needs of the particular applications planned for it.

Ample capacity available

Filing on large-scale magnetic drums permits maintenance of a complete record on each scheduled operation -- with alpha-numeric identification by job number, part number, work center and operation. Production control information may include the total of estimated or standard hours and the scheduled start date for the operation, with quantity ordered and quantity completed to date, etc. Cost data may also be included in the same record, for up-to-the-minute control over this phase of plant operations, too.

The unit record size for each scheduled operation may be from 12 to 120 characters as needed. For a typical unit operation schedule of 40 characters, a single large capacity drum will hold the records for 4500 operations. Up to ten such drums may be used without loss of access speed, so that a single system may be used to schedule as many as 45,000 separate operations.

The versatility of the File-Computer system is illustrated by the fact that accumulated machine load totals by week for each work center may be stored on the same large-capacity magnetic drums, or on a special high-speed drum unit which provides flexible multi-purpose storage for constants, intermediate results, in-process data, additional instructions for complex programs, etc.

Automatic scheduling

Processing new orders is simplicity itself. Input consists of merely a card for each order, containing job number, part or component code, quantity required, and due date, with an estimate deck or reproduced master deck of cards for each operation.

The order card is only sensed. Its data is stored in the system for application to the succeeding operations cards, which are in reverse sequence from the actual manufacturing sequence of operations.

From the first operation card, an extension is made of quantity ordered times the unit of standard or estimated machine hours for the operation. The scheduled machine hours are then distributed by week to the accumulated machine loads of the work center where the operation is to be performed.

Converting the machine hours into machine days, and working back from the due date, a scheduled start date for the operation is computed and punched into the operations card with the machine hours and reproduced data from the order card.

At this point, it is possible to start a separate high-speed sensingpunching unit to work creating the required number of job cards (number of machine days, plus one), each with complete instructions for the operation. (For this purpose, the new dual-feed sensing-punching unit may be used, with blank job cards in one feed.)

In any event, the entire data for the scheduled operation is also filed magnetically in an open unit record area located by random search. There it will be instantly available for each future reference.

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The start date of this operation becomes the due date for the next scheduled operation, and so on until the entire job is scheduled.

From the processed operation cards, complete production schedules can be tabulated immediately on each new job. In this way, the entire task of machine loading and production scheduling can be reduced to a few simple steps, handled intermittently whenever the File-Computer time is available.

Automatic unloading

As job cards return, punched with quantity completed, date, employee number, actual hours and rate, they are fed immediately into the system without sorting. Instantly, the machine load is reduced for the week and work center affected, and a new total is accumulated for the quantity completed in the production schedule file for the job and operation affected. At the same time, an extension is made of hours times rate, which is then punched into the job card for cost and payroll uses.

Move cards indicating job, part, operation and date are also processed by the File-Computer system and punched with the complete production data from the magnetic file for the operation completed, producing cards for reporting purposes. This processing also clears the file location for the operation completed, making it available for re-use on an incoming work order. (A special programming technique of random search permits such versatile use of the file capacity.)

Simplified plant control

Since production figures are kept current as fast as job tickets return to the tabulating department, keyboard inquiry will always produce up-to-the-minute data on machine loads and operation schedules. Complete reports can be read out anytime. Also, selective figures can be taken out for reporting overload and underload conditions by week and work center, scheduled operations which are ahead or behind schedule, etc. When re-scheduling is indicated, detailed figures

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can be taken from the schedule file for affected work centers. Then the complete re-scheduling job can be effected by the File-Computer according to new instructions.

The File-Computer can also handle the more or less inter-related applications of cost control, materials control, finished-goods inventory, sales statistics, and engineering design problems. Some of these records may be processed and stored simultaneously with production control figures. Others may be handled by clearing the magnetic drums, first transferring all file data to tapes or cards for temporary storage.

Considering the simplicity and speed of operation, with the tremendous scope of application, it may be said that the Univac File-Computer System offers many manufacturers the first practical opportunity of achieving <u>up-to-the-minute</u> control over all phases of plant operations.



UNIVAC FILE-COMPUTER SYSTEM

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